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A Hydrologically-Consistent Multi-Satellite Climatology of Water Vapor Transport, Evaporation, and Precipitation Over the Oceans

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Project hypothesis:

We will estimate WVT and evaporation (and their uncertainties) over the oceans and derive precipitation (and its uncertainty) using the hydrological balance equation.

Objectives & deliverables:

- Primary objective:

  Provide accurate and consistent monthly WVT, evaporation, and precipitation fields covering the global oceans using all available passive-MW data
- 10 + radiometers used
- Precipitation derived using hydrological balance equation
- Uncertainties in components used to estimate uncertainty in precipitation

- One-degree, monthly maps covering the global oceans for 1998-2009
- WVT components, WVT divergence, evaporation, storage, and precipitation + uncertainty estimates for each

NASA ENERGY AND WATER CYCLE STUDY
NEWS

Technical approach and/or methods:

- A measurement-based strategy using all available passive MW data
- Evaporation
  - Bulk formula
- Water Vapor Transport
  - Feature tracking
  - Evaluated using on-orbit simulation experiments
- Precipitation
  - Hydrological balance equation
- More direct remote sensing techniques have large uncertainties that are difficult to quantify (e.g., rain DSD, vertical profile, cloud vs rain partitioning, beamfilling, . . .)
- Sampling requirements for WVT and evaporation less stringent than precipitation

Technical approach and/or methods:

- Vertically integrated atmospheric water budget:

$$\frac{\partial V}{\partial t} + \frac{\partial C}{\partial t} + \nabla \bullet \left(V\vec{W} \right) + \nabla \bullet \left(C\vec{W}_C \right) = E - P$$

- Columnar water vapor:

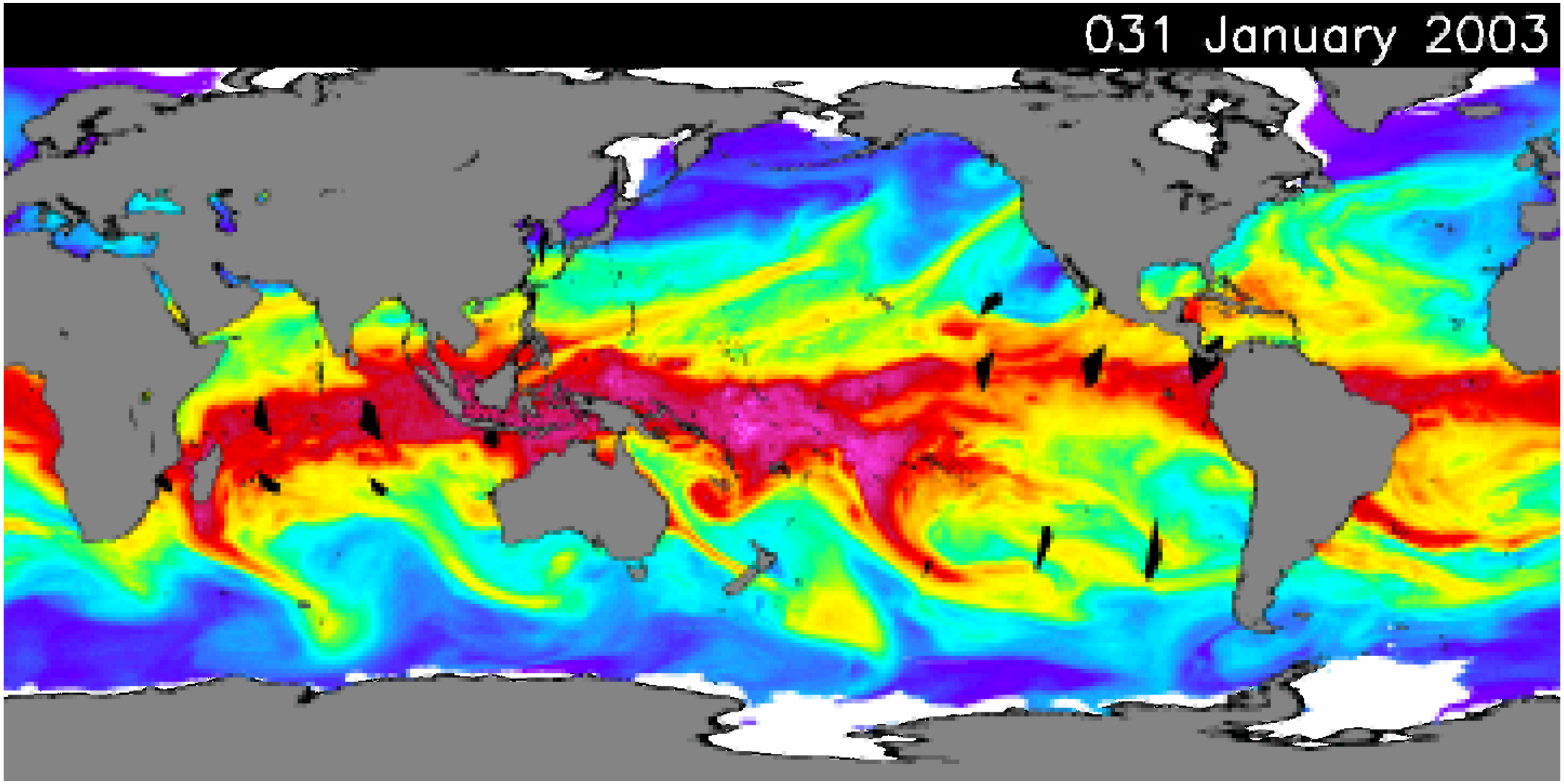
$$V = \int_0^{p_0} q \frac{dp}{g}$$

- Effective horizontal velocity of the water vapor column:

$$\vec{\mathbf{W}} = \frac{\int_0^{p_0} q\vec{w} \frac{dp}{g}}{V}$$

Water Vapor Transport

Animation created using SSM/I (F13,14,15), TMI, and AMSR-E



Data set needs:

- One-degree, monthly maps of WVT components, WVT divergence, evaporation, storage, and precipitation + uncertainty estimates for each
- Size: 0.2 MB per compressed file, 26 MB total
- Coverage: global oceans; Time period: 1998-2009 (11 years)

Project outputs:

- All datasets will be made available

Potential collaborations:

- Our consistent, multi-satellite, multi-sensor products will be available to the NEWS Team
- Leveraging of the DISCOVER project to provide SST, surface wind, water vapor, cloud, and precipitation fields derived from multiple sensors on multiple satellites
- Collaboration with other NEWS members to derive evaporation, and to compare the performance of different techniques for estimating WVT

Important outside linkages/resources:

- Current sensors:
  - SSM/I on DMSP F13,14,15
  - AMSU on NOAA-15,16,17
  - TMI on TRMM
  - AMSR on Aqua and Midori-II
  - WindSat on Coriolis
  - SSM/IS on DMSP F16
- Future sensors:
  - AMSU on NOAA-18
  - AMSU on MetOp-II
  - AMSR on GCOM
  - CMIS on NPOESS
- Linkage to TRMM and GPM

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Expected contribution to the NEWS objective:

- Provides key accounting of reservoirs and fluxes associated with global water cycle

- Provides increased understanding of closure accuracy assessments and error assessments

- Provides critical linkage between precipitation estimates and water cycle characterization along the NASA Water and Energy Cycle Roadmap

- Provides an independent comparison dataset for precipitation to assess errors and uncertainties
    - Will be the only remotely-sensed precipitation estimate that does not depend on microphysical or beamfilling assumptions

Issues, needs, and concerns: